

California's Statewide Pricing Pilot Summer 2003 Impact Evaluation

**Ahmad Faruqui and Stephen S. George
Afaruqui@crai.com
Charles River Associates**

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Outline

- **Design of the Statewide Pricing Pilot (SPP)**
- **Methodology and data**
- **Residential results**
 - Price elasticity estimates
 - Impact simulations

The genesis of the Statewide Pricing Pilot (SPP)

It is an outgrowth of the CPUC OIR (R.02-06-001) on advanced metering and demand response

The first large-scale scientific experiment focused on dynamic pricing for mass-market consumers

Customer enrollment began in April 2003; new rates became effective in July 2003 and will stay in effect through December 2004

SPP addresses several policy issues:

- What is the price elasticity of demand for electricity by time period?
- Does responsiveness vary by rate type, climate zone and customer characteristics?
- Will customers accept time-varying and dynamic rates?
- Are reductions in energy use and coincident peak demand resulting from widespread use of more economically efficient pricing sufficiently large to offset the metering costs required to implement rate reform?

The SPP is testing several rate options

Time-of-Use (TOU) rate

- Traditional two-part TOU rate
- Peak period from 2 pm to 7 pm
- Rates vary seasonally

Critical Peak Pricing-Fixed (CPP-F) rate

- TOU rate 350 days a year
- Much higher price during peak period on up to 15 days a year, which are called the previous evening

Critical Peak Pricing-Variable (CPP-V) rate

- Similar to CPP-F except they may be called in just 4 hours
- Critical peak period can vary in length from 1 to 5 hours between 2 pm and 7 pm
- Both treatment and control group consumers had volunteered into a smart thermostat pilot program funded by Assembly Bill 970

The above rates are layered on top of a very complex, five-tier, increasing block rate structure

Additional SPP design features

About 2,500 participants drawn from three investor-owned utilities allocated to various treatment and control groups

There are multiple price levels and ratios for each rate type in order to allow for estimation of price elasticities

A mandatory pilot was not politically acceptable

- Customers were randomly selected but not required to participate
- The pilot design attempts to mimic a voluntary “opt-out” pricing regime

Residential sample segmented into four climate zones

C&I sample segmented by size

- <20 kW and between 20 kW and 200 kW

The experiment includes four climate zones

Methodology and Data

Two demand models were used to estimate customer price responsiveness

A double-log functional form that expresses the log of peak and off-peak usage as a function of the log of peak and off-peak prices and cooling degree hours during each period

A constant elasticity-of-substitution (CES) functional form that expresses the log of the ratio of peak to off-peak usage as a function of the log of the ratio of peak to off-peak price and the ratio of cooling degree hours during the two periods; a supplemental equation that expresses daily energy usage is also expressed as a function of daily price and cooling degree hours

Both functional forms are estimated using the fixed-effects estimation procedure, which is widely used in the analysis of panel data sets

Data Characteristics

For the CPP-F and CPP-V rates, the demand models were estimated using values that were averaged over all days in the following three time periods

- Pretreatment period (June only)
- Non-CPP days in the treatment period
- CPP days in the treatment period
- Consequently, there are three time-series observations for each customer, with treatment customers facing a different price for each time period and control customers facing the same price each time

The demand models were estimated using pooled time-series, cross-section data

- A binary variable was used to test whether the price elasticity varies between CPP and non-CPP days for each climate zone. No statistically significant difference was found in zones 2, 3 and 4

For the TOU models, the regressions were run using values averaged over two time periods

- Pretreatment period (June only)
- All weekdays during the treatment period

Residential Analysis Results

Key findings for the CPP-F rate

Own-price elasticities for peak period energy use are statistically significant in zones 2, 3 and 4

- Range from low of -0.08 to high of -0.21
- Higher in the warmer zones 3 and 4 and lower in the cooler zones 1 and 2

Own-price elasticities for off-peak energy use are statistically significant in zones 1 and 2

- Zone 1 elasticity is -0.17 and -0.10

Cross-price elasticities are typically small and insignificant

All elasticities of substitution are small but statistically significant; they range between -0.04 to -0.16 , with higher values being observed in the warmer zones

The daily price elasticities in zones 3 and 4 are statistically significant and equal -0.06 ; those in zones 1 and 2 are not significant

Key findings for the CPP-V rate

The own price elasticity for peak period energy use is -0.21 and statistically significant

The own price elasticity for off-peak energy use is not statistically significant

Cross-price elasticities are typically small or not statistically significant

The elasticity of substitution is -0.21

The daily price elasticity is not statistically significant

It is important to note that these elasticities pertain to customers who had already volunteered into an earlier pilot program involving smart thermostats and therefore cannot be generalized to the population as a whole

Key findings for the TOU rate

None of the own-price or cross-price elasticities are statistically significant

The elasticity of substitution for zones 2 and 3 is statistically significant and ranges between -0.11 and -0.28

None of the daily price elasticities are significant

There are several possible reasons why the TOU price elasticities were not found to be statistically significant

- The sample sizes of the TOU customers may not be large enough to obtain precise estimates given the significant heterogeneity in these customer segments
- The TOU price ratios may not be significant enough to motivate any significant response
- Without a CPP rate that is exercised a few days each month, customers may forget they are on a time-varying rate
- Customers on a steeply sloping, five-tiered rate may find it difficult to respond further to a moderately high TOU price signal

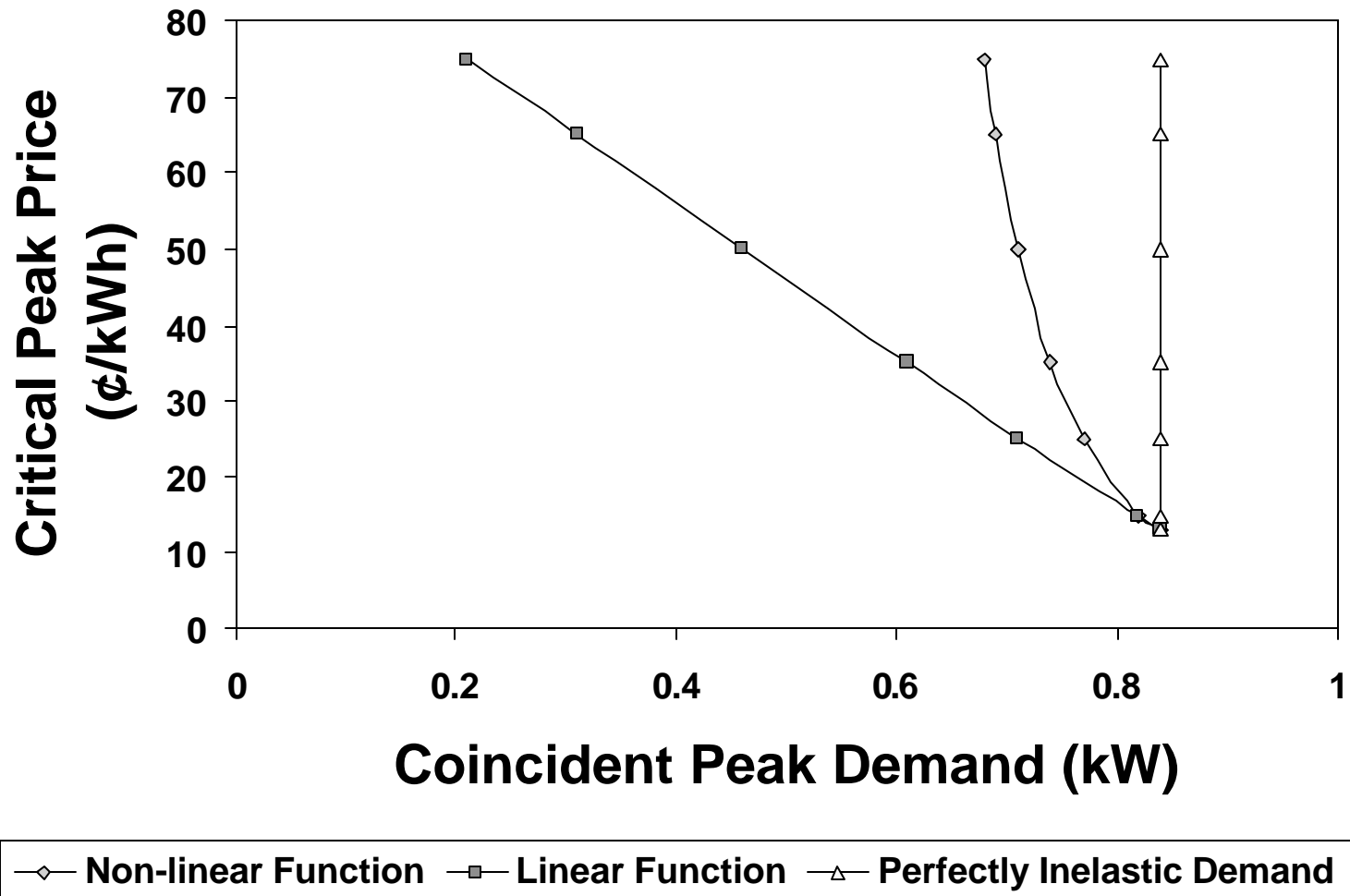
Rate impacts can be simulated by using the estimated demand models

The estimated demand models can simulate the impact for the rates used in the experiment and for a variety of other rates that are generally similar to the ones used in the experiment

They should NOT be made using the point elasticities in the previous slides, since point elasticities will tend to exaggerate the impact of large price increases and underestimate the impact of large price decreases

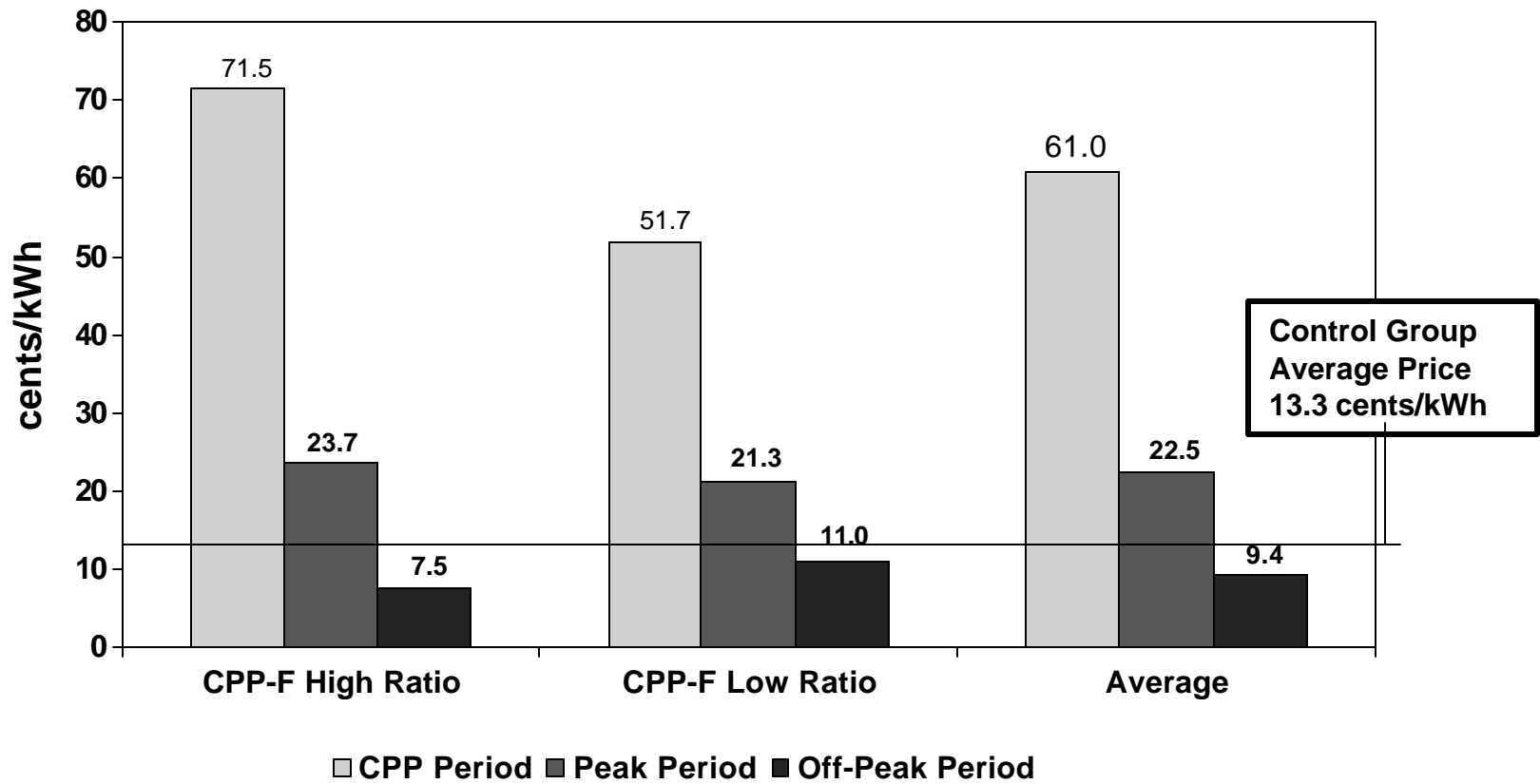
It is important to note that impact simulations require both own and cross-price effects, another reason why relying on just the point estimates of the own-price elasticity will mislead rather than inform policy analysis

A Double-Log example of how point elasticities overstate the impact of large price increases

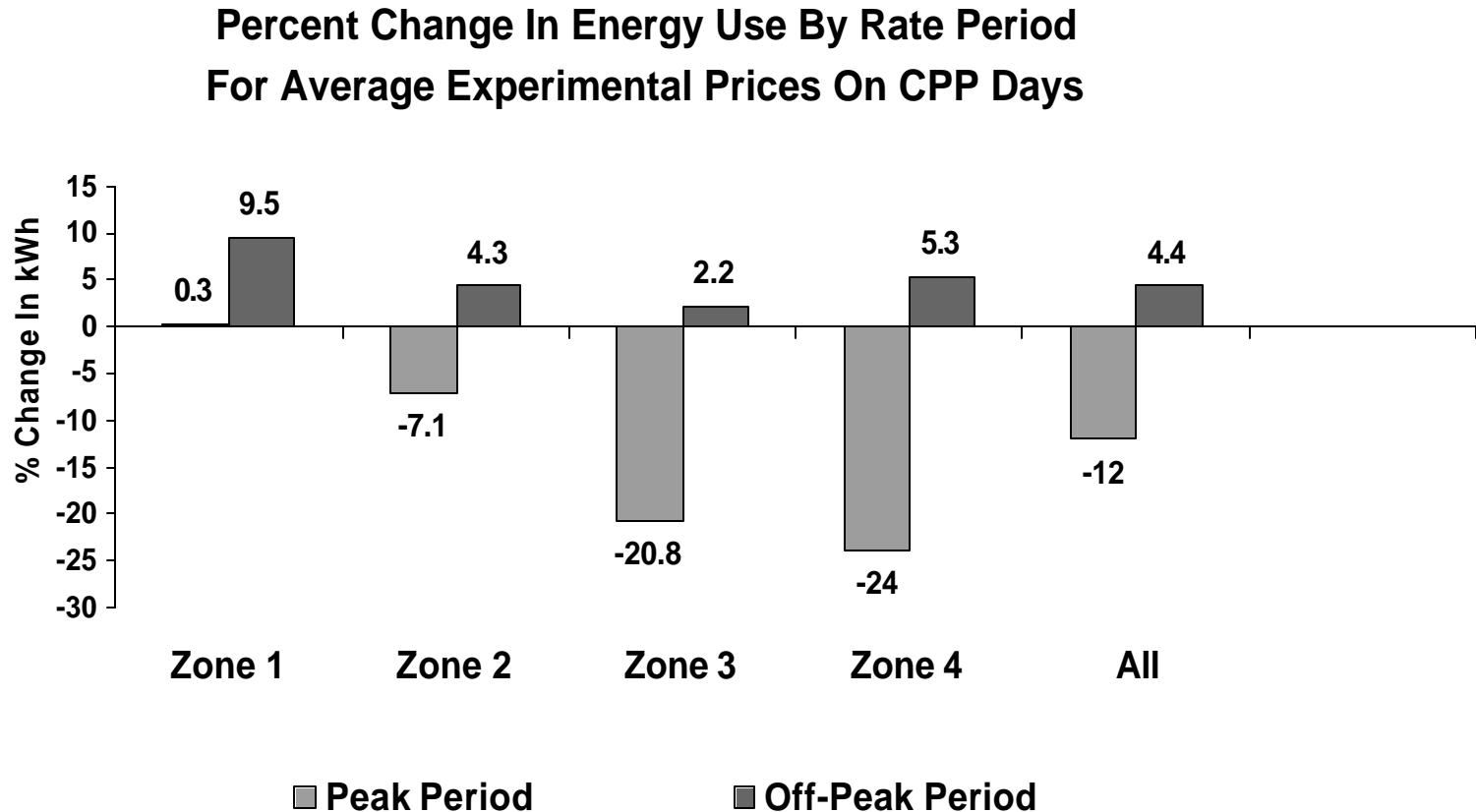


Impact analysis is based on the weighted average prices for treatment customers in each climate zone

Residential Price For Consumer At Midpoint of Tier 3
(Weighted Average, Climate Zone 2)

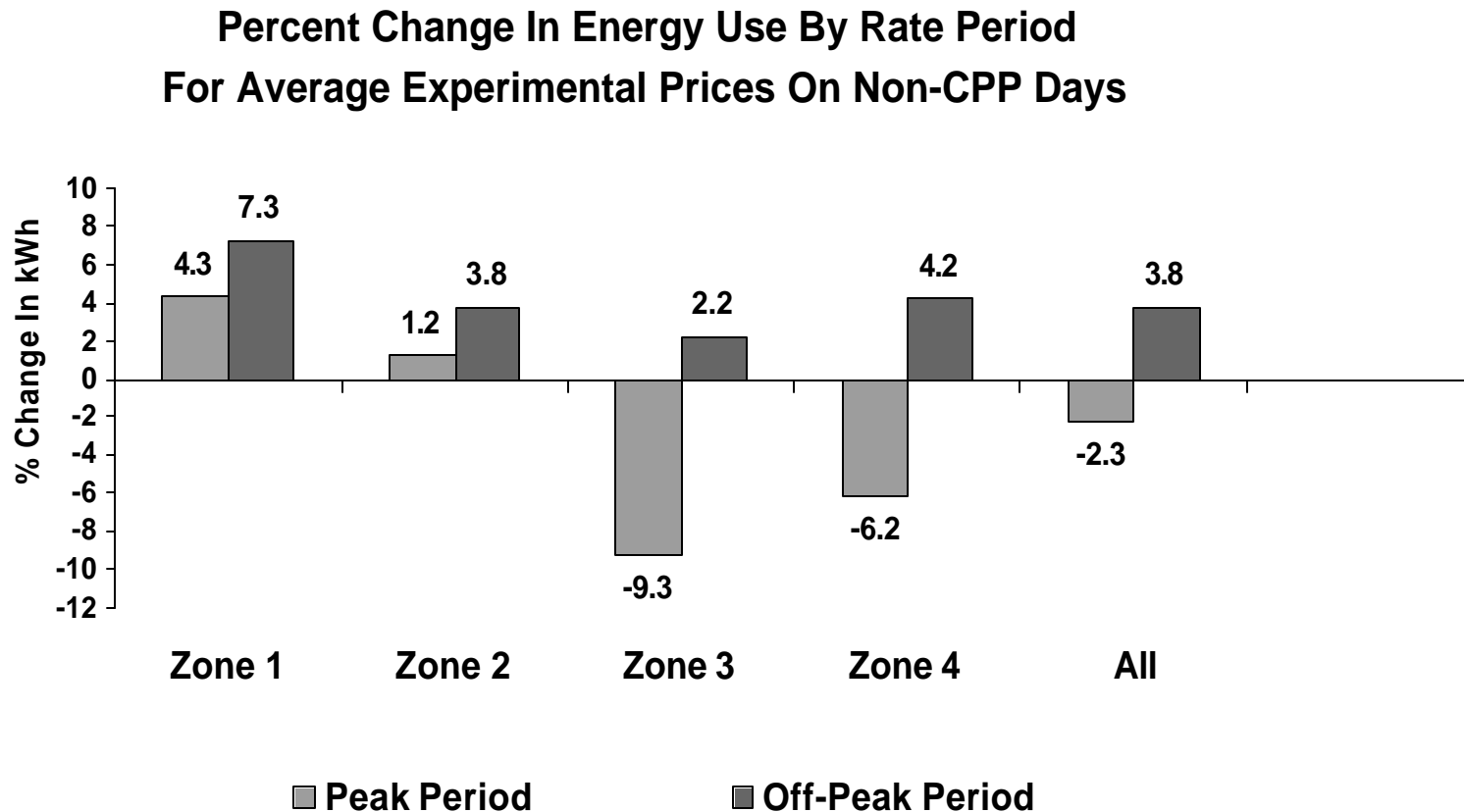


Peak period impacts are larger in the hotter climate zones than in the cooler zones



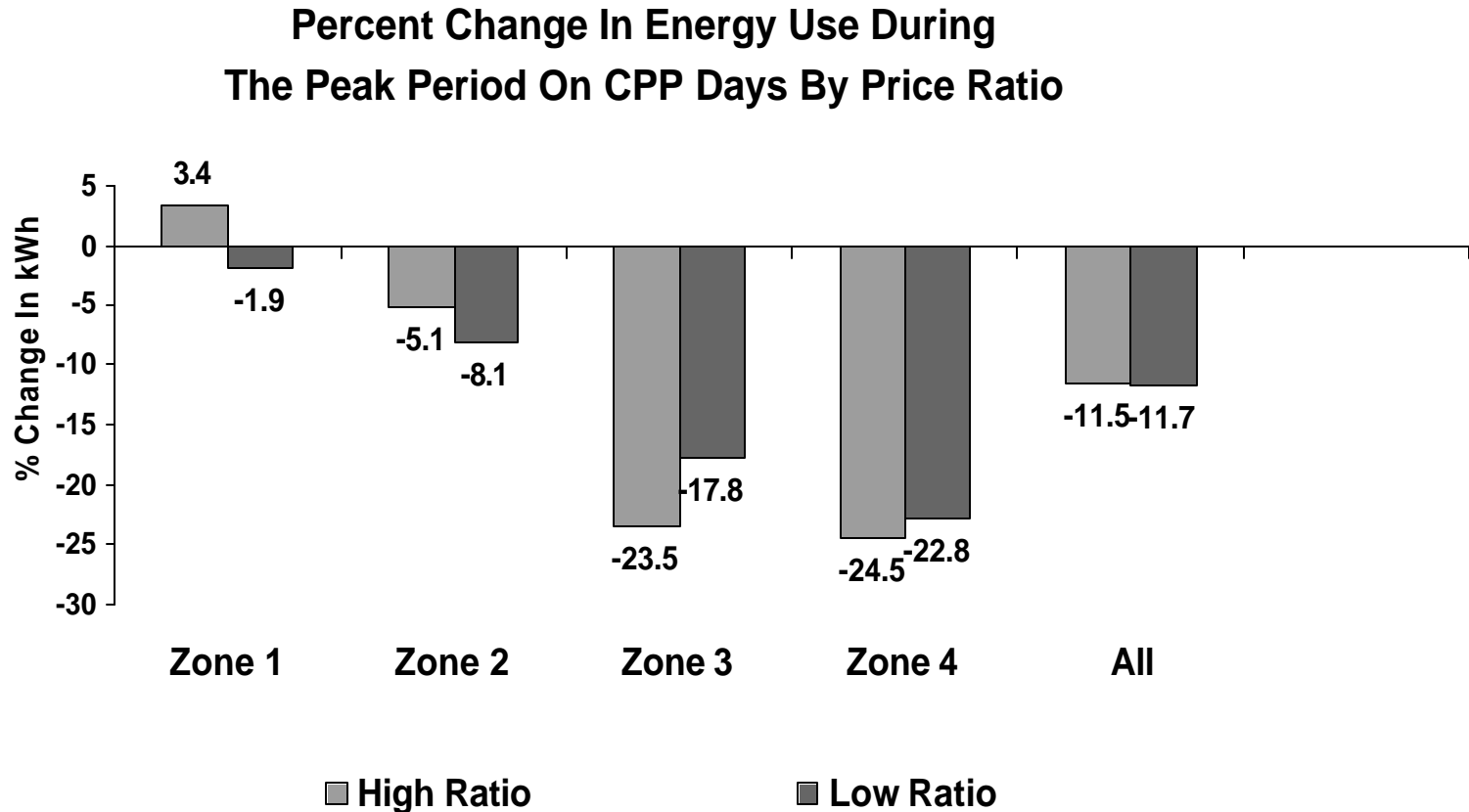
These estimates come from a sub-sample of customers who volunteered into a smart thermostat pilot and may not be generalizable to the general population of residential customers

Impacts are considerably smaller on non-CPP Days, which have lower peak prices



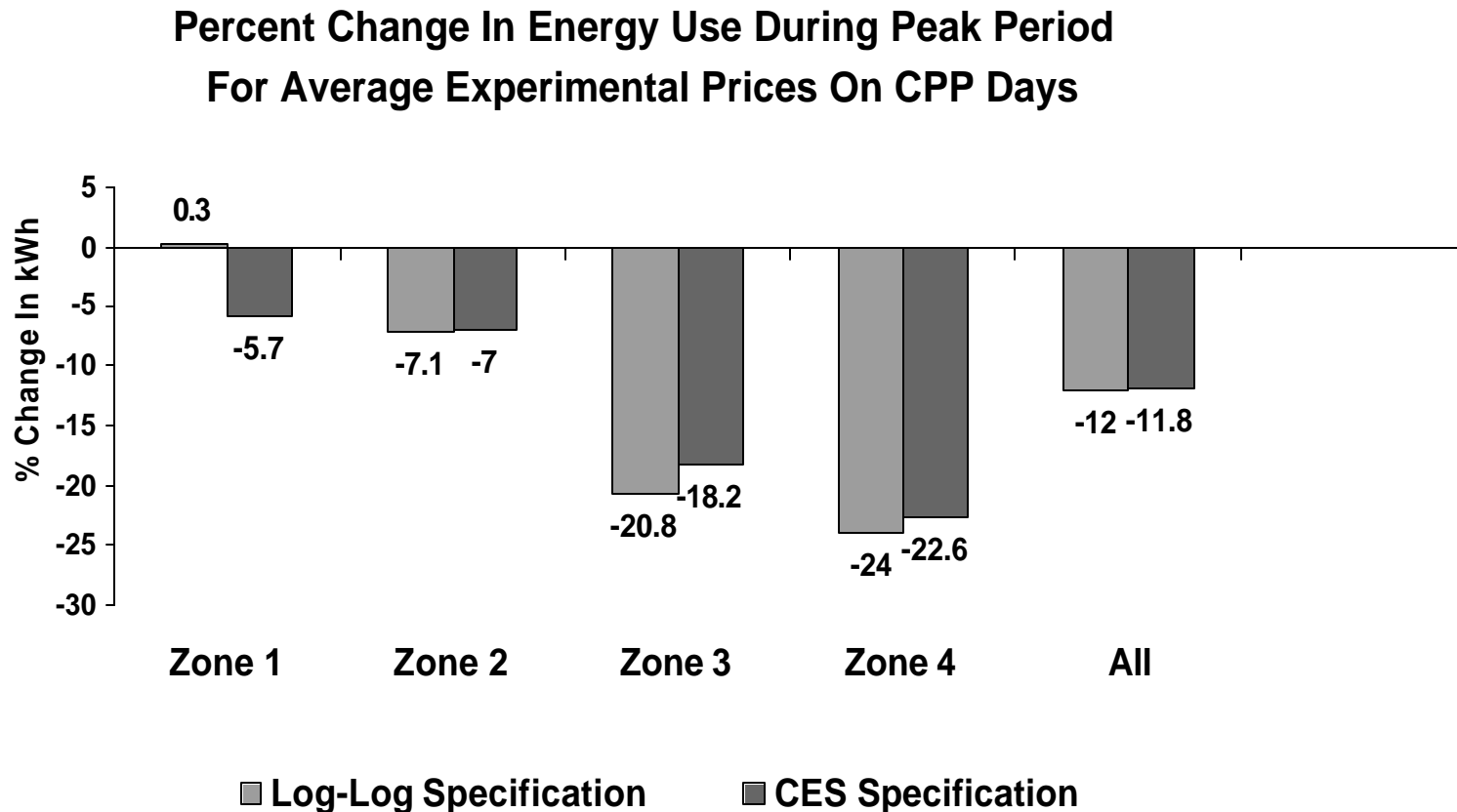
These estimates come from a sub-sample of customers who volunteered into a smart thermostat pilot and may not be generalizable to the general population of residential customers

Impacts vary somewhat by experimental rate



These estimates come from a sub-sample of customers who volunteered into a smart thermostat pilot and may not be generalizable to the general population of residential customers

Impacts also vary somewhat by model specification



These estimates come from a sub-sample of customers who volunteered into a smart thermostat pilot and may not be generalizable to the general population of residential customers

Conclusions

Customers show significant response to both the CPP-F and CPP-V rates

Impacts are higher in the hotter zones for both CPP and non CPP days

Responses are substantially higher on CPP days than on non-CPP days

- For all zones, the CPP day impact is -12% and the non-CPP day impact is -2.3%

CPP day impacts differ slightly between the two experimental rates within the CPP-F rate

Results are generally similar across the two functional forms tested in this study

Customers do not respond to TOU rates

Next Steps

Assess whether price responsiveness differs between really hot days, hot days and typical weather days

Assess whether price responsiveness varies with customer characteristics such as equipment ownership and size

Analyze the response of residential customers in the Information Only treatment cells of Track A (Zones 2 and 3)

Analyze the response of residential customers in Track B who face an enhanced community-based information treatment

Evaluate price responsiveness during Winter 2003-04

Evaluate the response of small C&I customers

These results will become available some time in July